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of the

Research and Educational Activities

in

Machine Computation

by the

Cooperating Colleges of New England

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Computation Center
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

PREFACE

As **forecast** in our last two reports, use of the 704 has now risen to the point of overload. The history of the use, in terms of hours per month, for 1959, is given below:

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
MIT	129	132	168	153	182	153	158	174	155	154	135	176	1869
N.E.	26	48	66	43	56	92	80	45	37	29	37	81	640
*	18	20	28	33	33	40	36	35	28	43	28	27	369

*Service use by Center staff for common benefit. These involve development and testing of new compilers or routines, such as the present operator routine, which when developed will be of help to all users of the Center.

It is our experience, that, allowing for normal maintenance and other non-productive service activities as well as for unscheduled breakdowns, the maximum efficient load of allocated computing time for the equipment at the Center is about 120 hours per month per shift for the two shifts available under the present agreement with IBM. In many months more hours than this are available; but if more hours are allocated in advance, then the natural fluctuations of usage generate back-logs and delays which handicap all users. It is to be noted that, during most of the months of the past year, the load was substantially greater than the optimal 240 hours for two shifts. Part of this extra load was taken care of by Saturday runs and by encroachment on the third (IBM) shift, but part was squeezed into an overcrowded schedule, which was paid for by delays in getting work done and a consequent slowing down of all computing activity, a highly undesirable situation. Immediate measures to ameliorate the effects of the coming spring overload are to schedule two Saturdays a month, to regularize our encroachment on the third shift, and to improve the efficiency of our operator routine. But other measures must be taken as well.

One palliative action has been to restrict allocation of machine time for some categories of MIT users, giving preference to class and thesis use and to projects which are, primarily or incidentally, developing programs or techniques which will be useful to other users; and cutting down on long routine computing runs.

A more positive action is to push our research on time-sharing techniques. We now have a typewriter connected to the 704, which is working on a time-sharing basis with our regular operator routine. When it has been checked out, it will be available for new programs to be debugged, coincidental with regular computations being carried out on other programs, thus making possible parallel access to the machine. The 704 cannot effectively handle more than one or two such time-sharing channels; but if or when a 7090 is installed, 10 or more substation consoles, some even in other parts of the Institute, could be attached on a time-sharing basis. In this system, any of the typewriter consoles could at any time request service from the computer. The computer would execute small requests without delay and would schedule larger ones so that interference with the other parallel machine activities is minimized. Only thus can there be efficient contact between many users and a high-speed computer.

The Center staff believes that such a system will be the normal input procedure in future machines, and has started intensive programming and equipment development to have time-sharing consoles ready for a 7090 when it arrives. The aspects of this program are given in more detail later in this report.

In the meantime, other programming developments are in progress which will aid various 704 users. The Linking Segment System, described later in this report, will enable the programmer to combine already developed subroutines in more than one "language". The non-numerical compilers COMIT and LISP, described in earlier reports, are nearing completion and we hope will be available for use by others perhaps by fall.

We have also begun to investigate the possibilities of use of machines in the educational process. Computers, can, of course, aid in grading examinations and do other clerical tasks incidental to large classes. But computers also can be programmed to carry out some of the detailed question-and-answer interchange which occurs in recitation sections. The Center staff is now working with the Language Department at MIT to program the 704 to guide a student through some of the phases of learning a new language, and are discussing the possibilities of training students in the details of mathematical manipulation by machine. Here the machine would pose questions for the student to answer and, on the basis of the answers, would go on to other questions, as in a recitation section. To avoid intolerable congestion at the main input console, several students must be able to work with the machine simultaneously, sharing machine time with regular computation. Therefore, further development of this research will shortly require a flexibility the 704 lacks but the 7090 does possess. Development of these possibilities should help to solve the problem of giving individualized training at all levels without excessive demands on the time of able teachers.

Other developments in Programming Research are reported in Chapter I of this report; Educational Activities in Chapter II. The usual Summary of Operations makes up the rest of the Report.

Philip M. Morse
Director

TABLE I

Univ.	Field	Problem Title	Prob. No.	Hours of Computer Time Used	Applicant
MIT	Elec. Eng.	Optimum model design	M734	7.18	Leiter, M.
		Solution of an electrical network using a digital computer	M736	4.64	Goldberg, S.H.
		Digital picture processing	M739	4.64	Gronemann, U.F.
		Describing function for relay nonlinear system with relay	M759	1.15	Jaffee, R.C.
		Alphabetical character learning routine	M766	2.44	Lo, H.W.
		Eigenfunction determination	M776	5.79	Jordan, K.L., Jr.
		A non-stationary prediction system for finite time series	M781	.00	Barndt, R.L.
		Measurement of picture statistics	M783	1.68	Shi-Tao Huang
		Depth dose correction calculations	M793	.63	Swenson, J.R.
		Institute of basic mathematics	M800	.00	Howard, R. A.
		Solution of simultaneous inequalities	M804	3.64	Bruce, J. D.
		Binary coding investigation	M816	.91	Peterson, W.W.
		Solution of Wiener-Hopf equation	M823	2.86	Ronen, M.J.
		General method of design of the adaptive control system	M836	4.06	Chi, C.H.
		A routine to solve diode-source networks	M841	.22	Fish, J.W.
		Computer-aided design	M846	.62	Ross, D.T.
		Editing text for immediate display	M856	.58	Somin, M.E.
		Dynamic control of an adiabatic reactor	M857	1.21	Boyle, T.J.
		The switching characteristics of the varactor-diode parametron	M869	.09	Woodward, C.E.
		Control and optimization of dynamic systems	M878	.36	Kipiniak, W.
		Program analysis - machine debugging techniques	M883	.00	Uhlik, R.J.
		Study of Rayleigh faded binary erasure channels with crossover	M911	.44	Pfeiffer, R.R.
	Elec. Syst. Lab.	Scattering of radiowaves on internal reflexion	M829	.56	Pitteway, M.L.
	Geol.	Magneto-telluric diffraction	M277	.64	Madden, T.R.
		Fourier synthesis	M311	.96	Simpson, S.M.
		The use of the logistic curve, as fitted by least squares, to forecast U.S. mineral production	M361	1.92	White, J.A.
		Structure of cahnite	M421	1.09	Prewitt, C.T.
		Some thermal consequences of the theory of continental growth	M700	3.00	Downs, J.P.
		Structure of dumortierite, B Al7 Si3 018	M715	1.21	Poljak, R.J.
		Crystal structure of narsarsukite, NA2(TIFE)SI4011	M741	.87	Peacor, D.R.
		Relative energies of loops of tetrahedra	M742	1.00	Buerger, M.Y.
		Simulation of density distributions from gravity data with application to mapping a glacier	M757	6.00	Sax, R. L.
		Motion pictures of scope demonstrations	M769	.22	Simpson, S.M.
		Control parameters for an automatic single-crystal counter diffractometer using equi-inclination geometry	M828	.46	Prewitt, C.T.
	LNS	Development of methods for the inversion of ill-conditioned orthosymmetric matrices of high order	M794	1.59	Langley, J.
		Solution of Q-value equations	M877	.00	White, R.E.
	Math.	Pattern recognition	M585	1.83	Minsky, M.
		Formal integration on a digital computer	M710	7.14	Slagle, J.R.
		Automatic selection of starting values for iterative procedures	M728	2.63	Polansky, R.B.
		Strategies for Blackjack	M837	1.15	Thorp, E.O.
	Mech. Eng.	Evaluation of an equation of state for steam	M141	3.91	Skinner, F.D.
		Elastic-plastic instability in shear fracture	M189	4.08	McClintock, F.

N855. SCHEDULING GROUPS OF INTERRELATED ACTIVITIES

The problem is to determine which elements of a set of (M) elements can occur together in a subset when restricted by (N) known subsets of these elements declared to be mutually exclusive in the new arrangement.

The planned solution involves assigning a number from 1 to (M) to each of the elements and computing a distinctive number for each of the mutually exclusive combinations occurring as the known subsets are fed to the machine. In large problems, these distinctive numbers will be placed on tape and fed back to the machine in a later pass to remove the combination from the array representing all possible combinations.

Norman B. Andrews
University of Maine

M856. EDITING TEXT FOR IMMEDIATE DISPLAY

This problem will be concerned with designing a computer program that will allow editorial work on a given piece of text in such a manner that the text in its edited form is immediately available in a visual display. This example of man and machine interaction may prove useful in editing commercial copy.

The program will allow both additions and deletions of text, punctuation marks, spacing and capitals at any point in the original text. As additions and deletions are made, all words in the text will automatically shift so as to keep the margins uniform. Any words making for more than a predetermined number of characters on a line will be shift to the next line of text. In the case of additions to the text, material run off the bottom of the page would be stored in a separate memory for use in starting the next page. This run off text will not ordinarily appear in the visual display.

Martin E. Somin
Electrical Engineering Department

M857. DYNAMIC CONTROL OF AN ADIABATIC REACTOR

This work is a continuation of work entitled, The Dynamics and Control of a Heterogenous Catalytic Reactor -- simulation of reactor dynamics. It will involve the estimation of rate constants in an adiabatic reactor operating in the unsteady state.

Thomas J. Boyle
Electrical Engineering Department

VI. PUBLICATIONS OF THE CENTER

6.0 Computation Center Memoranda

There are several types of internal reports emanating from the Center. These are identified by the following letter designations: CC for memoranda, CCR for reports, and CCF for forms and notices. Although certain Computation Center memoranda are for internal circulation only, there are others which are of specific interest to all 704 users. The latter reports are distributed to 704 programmers at the time of printing. A number of these are available on request as long as the supply lasts. These memoranda are starred (*) in the following list:

*CC-50-7	Revised and Up-Dated Index of Available Share 704-709 Subroutines, F. M. Verzuh, August 31, 1959 (38 pages)
*CC-50-8	Revised and Up-Dated Index of Available Share 704-709 Subroutines, F. M. Verzuh, November 6, 1959 (39 pages)
*CC-90-9	Bulletin, October 26, 1959 (2 pages)
*CC-90-10	Bulletin, December 30, 1959 (1 page)
*CC-138	Description of MI PMPK, Post-Mortem Package, R. R. Brown, December 10, 1959, (8 pages)
CC-139	Final Description, Real-Time Buffer Chassis; Preliminary Description of Programming System to be Used; Suggested Further Work to be Accomplished, H. Teager, June 15,1959
*CC-141	A Technique for Precise Computation with Factorials in a Digital Computer, F. J. Corbató, June 16, 1959 (7 pages)
CC-142	SOS System, P.Wegner, September 29, 1959
CC-143	An Edit Program for BCD Tapes, F.J. Corbató and M. Merwin, October 20, 1959
CC-144	Changes and Additions to SAP, M. Merwin, November 25, 1959

*CC-145	A Linking Loader, F. J. Corbató and J. McCarthy, October 27, 1959, (14 pages)
*CC-147	FORTRAN Modifications and Additional Format Features, December 21, 1959, (3 pages)

6.1 Computation Center Forms

In the following list, the starred (*) forms are those necessary for initiating and running a problem on the 704 computer.

*CCF-1	Policy for 704 Computer Usage
*CCF-2a	Problem Application Procedure
*CCF-2	Application Form for Computer Usage
CCF-3a	Problem Approval Form
CCF-4	Coding Sheet
*CCF-5	Card Processing Requisition
*CCF-6	704 Performance Request and Result Sheet
CCF-7	Approval Form for Additional Time
CCF-8	Progress Report Form
CCF-9	Quarterly Time Allotment Form

6.2 Professional Society Papers

During the past six months, the following members of the Computation Center staff presented papers:

1. Professor Philip M. Morse spoke on "Operations Research" at the Mathematics Research Center, U.S. Army, held at the University of Wisconsin on October 30-31, under the sponsorship of the National Bureau of Standards.
2. Dr. Frank M. Verzuh spoke on "Real Time Communication with the MIT-IBM 704 Computer" at the 6th Annual Computer Symposium, University of Denver, held at Estes Park, Colorado on July 31, 1959.
3. Dr. Frank M. Verzuh spoke on "Report on 1959 International Conference on Information Processing" at the SHARE XIII meeting held at Seattle, Washington on August 21, 1959.